THE GENUS TABANUS IN AUSTRALIA.

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(With One Text Figure.)

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The genus *Tabanus* is a large world-wide and medically important group of blood-sucking flies of which over 100 species have been recorded from Australia. No subdivision of their enormous numbers has proved satisfactory, but characters of obvious group value, characters tested for nearly all the species in Australia, suggest a manner in which a subdivision may be built up.

It has become apparent that part of the Australian element forms one or two groups that are probably endemic forms isolated in the Australian region; or perhaps they have their near allies in South America, the others being mainly groups normal to the tropical Indo-Pacific area, and two species only having affinities with the Holarctic Tabanid fauna.

The division here proposed relies upon a new method of using the frontal measurements, and for the purpose of the present paper, the frontal proportions used are those limited to the area enclosed by the four eye-corners. The notes added include the more important data gathered when examining the collections in Sydney which include the material studied by the late E. W. Ferguson and the late F. H. Taylor, and the bred material in the collection of Miss K. English. The accompanying figure explains the terms used.

Key to the Subgenera of Tabanus.

1. Species with narrow frons which is never less than four times longer than broad between the four eye-corners. Those species that have this low proportion, never have the appendix to the vein R_4, and this appendix rarely occurs elsewhere .. *Cydistomyia* Taylor

   Species with a broad frons, being never more than four times longer than broad between the four eye-corners, and if as much as four times, then the appendix is present on vein R_4; it is usually present elsewhere 2

2. Frons exceptionally wide and diverging towards the antennae. The eye-margins are so rounded that only the upper corners are definite. From the upper corners to the subcallus, the length of the frons is one and a half times the width measured at the uppermost point of the subcallus .. .. *Dasybasis* Macq.

   Frons not so wide. All eye-corners are well-defined and the area between them is two or more times longer than wide 3

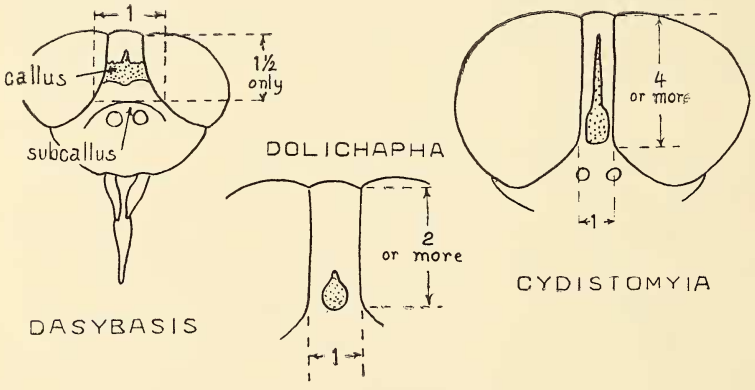
3. Frons without or with only one callus. Eyes hairy to bare and in life usually green with red reflections, rarely all red .. .. *Dolichapha* Enderlein

   Frons with two calli, and with the eye-margins strongly converging towards the antennae. The eyes are bare and, in life, are conspicuously variegated .. .. *Tabanus* Lin.

In the above key, the frontal measurements involve general proportions and were gained by using a micrometer-eyepiece which gave the larger species a frons length of 30 to 36 units on the measuring scale. This yielded a formula in numbers that represents: (1) the length of the frons between the eye-corners at the summit and those near the antennae; (2) the width between those eye-corners near the antennae; (3) the width between the eye-corners at the summit. An example of such measurements taken, may be represented by the numerals 31 : 6 : 7, each of the three numbers representing the three readings respectively.

The relative frontal proportion was calculated by using the length of the frons and the width between those eye-corners nearest the antennae, and this proportion, in the example, becomes $\frac{31}{6} = 5{\cdot}17$. Ignoring the decimal figures, the frons proportion becomes five times longer than wide. These figures would not conform to published measurements of the frons, as authors have been including the length of the subcallus in the length of the frons; moreover the method here used has the convenience of restricting the frontal area to that which permits a ready estimate of proportions.

The difference between the width of the frons at the summit, and that near the antennae (one unit in the example) shows the converging and diverging frons, a feature of some significance, but the frons is liable to slight variations owing to a general trend for the frons on some specimens to collapse slightly by shrinkage after death, especially so at the summit.



TEXT FIGURE.

The head of subgenus *Dasybasis,* seen anteriorly. From the summit to the subcallus the slope causes a foreshortening in the figure and the true length invariably is about one and a half times the width at the subcallus. The callus shown reaches from eye to eye and has a short extension.

Subgenus *Dolichapha* has the frons never less than twice, and never more than four times as long as the width between the eye-corners near the antennae. The callus shown is rather pear-shaped and is widely separated from the eye-margins.

Subgenus *Cydistomyia* has a very narrow frons which, at its widest, is never less than four times longer than broad. The callus shown is narrowly separated from the eye-margins and it has an extension that nearly reaches the summit.

Subgenus Dasybasis Macquart.

Dipt. Exot. suppl. 2, 1846, 25.—*T. gentilis*-group Hardy, Stylops, 3, 1943, 47.—Section 2, Hardy, Proc. Linn. Soc. N.S.Wales, 64: 1939, 42 (in part).

Genotype: *Dasybasis appendiculatus* Macquart (monotypical).

The inner margins of the eyes diverge so widely towards the antennae that eye-corners are apparent only at the summit, from where the measurement is taken to the top of the subcallus (marked by a groove); and the frons is only one and a half times longer than it is wide at that groove level. The eyes are densely hairy and the appendix is present on vein R_4. The characteristic spots on the wing are replaced on one species by a general dark suffusion over much of the wing.

Key to Species and Subspecies of Dasybasis.

1. A brownish species with spotted wings; small and distinctive in appearance .. .. *appendiculatus* Macq.
   Black or grey species 2
2. Wings with conspicuous spots 3
   Wings suffused with black; a black species with abnormally long hairs on the frons .. .. *neolatifrons* Ferg. & Hill
3. Black species with long hairs on the frons. Annulations of the antennae normal .. .. .. *froggatti* Ric.
   Greyish species with short scanty hairs on the frons .. 4
4. Annulations of the antennae normal, being about one third the total length of the third segment .. *gentilis* Macq.
   Annulations of the antennae very small, being about one quarter of the length of the third segment, and narrow in proportion .. .. *gentilis* subsp. *imminutus* n.subsp.

Tabanus appendiculatus Macquart, 1846.

Ferguson has identified a series of specimens under this name, and two of these have the frontal proportions of 13 : 9 : 5 and 14 : 10 : 5, making the length about one and a half times the width. The annulations of the antennae tend to amalgamate, thus causing them to appear to have a reduced number on most specimens. The species seems to be confined to the eastern side of Australia.

Tabanus gentilis Erichson, 1842.

A specimen from Mangalore collected by White, has its frontal proportions 15 : 11 : 6, and my notes refer to a slight extension to the callus, seen on all specimens; but this is a feature missing in *T. froggatti*. The annulations cover fully one third of the third antennal segment, but are not quite as long as those on *T. froggatti*. This form is known only from Tasmania, the type-locality for the species.

Tabanus gentilis subsp. imminutus new subspecies.

This form is referred to *T. gentilis* by Taylor and by Fuller, but all their specimens seen from New South Wales (Armidale, Dorrigo, and Barrington Tops), and also from Victoria (Ararat), differ from the typical form by having the annulations of the third antennal segment so conspicuously reduced in diameter and length, that the subspecies stands morphologically distinct in this character at least. Of the total

length of the third antennal segment, these annulations cover only one quarter, and the general reduction is somewhat in conformity with the trend to limit these annulations seen on *T. appendiculatus*, where the segments tend to become fused together. The present species is definitely known from the mountain regions of Victoria and New South Wales; the record from Western Australia is evidently made in error through a misplaced locality label.

Tabanus froggatti Ricardo, 1915.

So far, this species is known only from Mt. Kosciusko and a wide area around that mountain including Canberra. It is quite a valid species, shown to differ slightly in the larvae, and also it conspicuously differs in the annulations of the antennae.

Tabanus neolatifrons Ferguson & Hill, 1921.

On the type of *T. latifrons* Ferguson (name preoccupied) the proportions of the frons are 18:12:6, and in no way does it differ in shape from other species of *Dasybasis*. The figure given in Ferguson 1921 (Pl. 2, fig. 1) is misleading, as it shows a rather parallel frons and all the eye-corners well defined, but the description states correctly that it is "very broad anteriorly, distinctly narrowed at vertex". The species is only known from Tasmania.

Subgenus Dolichapha Enderlein.

Enderlein, Deut. Ent. Zeit. 1930, 66.—Sections 2 (in part) and 3, Hardy 1939.

Genotype: *T. gregarius* Erichson, Tasmania (monotypical).

The frons ranges between twice and four times longer than wide and the eyes are hairy or bare. The appendix on vein R_4 is nearly always present and it is invariably so when the frons approaches its narrowest proportions.

Many species in this subgenus have been confused in literature and in collections, but there appear to be several natural groups under it that are able to be isolated, one from the other. The more typical species, belonging to the *gregarius*-group, are all dark flies varying in frontal proportions between twice and two and a half times longer than wide, as far as yet known; and the nine species are between 9 and 13 mm. long except *T. cirrus* Ric., which is 15 mm.

Key to the Species of the gregarius-group.

1. Callus separated from the eyes by a pulverulent strip .. 2
   Callus reaching from eye to eye 3
2. Callus small with a short extension .. *cirrus* Ric.; *dixoni* Ferg.; *dubiosa* Ric.; *tasmanicus* Ferg.
   Callus without an extension. Costal border of wing strongly suffused fuscous .. .. *gregarius* Erichson
3. Callus with a short broad extension .. .. *indefinitus* Taylor
   Callus without a definite extension, but may taper from the base towards the summit uniformly 4
4. Callus extending less than half-way towards the summit *flindersi* Ferguson; *hobartensis* White
   Callus large, covering the frons over half-way towards the summit .. .. *imperfectus* Walker

One of White's specimens of *imperfectus* has its frons with the proportions 15:7:5; *gregarius* has 16:8:6; *hobartensis* and *tasmanicus*, both identified by Ferguson, have 17:8:6; *flindersi* paratype has 20:10:8; *dixoni* paratype has 21:10:8 and *cirrus* has 25:10:8.

Tabanus microdontus Macquart, 1847.

One of White's specimens from Mangalore has the frontal proportions 20:8:6, and a larger one identified by myself has its proportions 24:10:8, giving the length two and a half times the width. The callus is very broad and wedge-shaped, two thirds the width of the frons basally; but, as the sides are indented, the indentation may be regarded as marking where the enormous extension begins, the sides forming a gothic-shaped arch nearly reaching the summit of the head.

The male described as *wynyardensis* Hardy 1915, and some others have normal eyes, the facets being enlarged over the central area and brown. The line of demarcation between the two sets of facets ends at the frontal eye-border, level with the antennae.

The vein R_4 is entirely without an appendix, leading White to suggest that the fly may be related to *T. victoriensis*, and it is difficult to see any close relationship with any of the species under *Dolichapha*. It may stand as an intermediate form between this and the *Cydistomyia*, retaining a primitive frontal character of the latter subgenus.

Tabanus neocirrus Ricardo, 1917.

Under the name *T. bassii* Ferguson 1921, stands a complex of possibly three species, including two from Swansea (Tasmania) which is the type locality of *T. neocirrus*. These two specimens have the frontal proportions of 15:8:7, and 17:8:7, whereas these measurements on specimens from Wynyard, recorded in Hardy 1934, have their proportions varying from 20:8:7 to 16:6:6. The former shows the length to be twice, the latter two and a half times longer than wide, indicating a possible confusion in identities.

Tabanus regisgeorgii Macquart, 1838.

Three names are standing as synonyms of this species. No authentic specimens were found under *postponens* Walker 1848, but specimens otherwise placed as such have the frontal proportions of the present species. The frons on the type of *spadix* Taylor 1916, has the frontal proportions 14:8:5 and the two labelled as being the type of *brisbanensis* Taylor 1917, have respectively 16:8:7 (in Sydney) and 18:9:6 (in Brisbane). The species occurs on the coast from Northern Queensland southwards to Western Australia and it may be subject to geographical variation over this long coastline.

Tabanus regisgeorgii subsp. diemeniensis Ferguson 1921.

Taylor included this island form in his *brisbanensis*, but Ferguson proposed using another name as it does not have the enlarged facets on the male eye. The type-female has the frontal proportions 15:8:7 and two paratypes have 15:8:6. The fly is very abundant in Tasmania, occurring over tidal marshes of the estuaries, and apparently it breeds in the mud of brackish water.

Tabanus circumdatus—complex.

Ricardo brought together several names into this complex, and on account of the close affinities between the species, she placed the names as synonyms of *circumdatus* Walker. It became generally recognised that her rendering was not in accord with the original descriptions. It appears that, after she saw White's material collected in Tasmania, with one species selected as being the *circumdatus* of Walker, this new rendering was generally accepted. As far as now can be ascertained, every specimen sent to England for comparison was of the same species as that of White, and the allied species were, apparently, never submitted for comparison. Ferguson has gathered together a number of specimens belonging to the complex and these await study; none of them bears an identification label. All those that have been isolated as named species belong to the one species *circumdatus* as identified by White. This does not agree with *circumdatus* as described by Walker. Already from the complex originally given three species have been isolated, but their exact identities need confirmation.

The list given by Ricardo, with two subsequently added, was:—

T. acutipalpis Macquart 1854 (King Island, Tasmania) : all white hairs on the palpi and stated to be 11 mm. long. Both Ricardo and Ferguson recorded that the type material covers specimens larger than *circumdatus* accepted by them, namely over 15 mm.

T. edentulus Macquart 1848 (Tasmania) also has white hairs on the palpi and is 11 mm. long. White gives 11 to 14 mm. and his species falls to *exulans* Erichson.

T. hebes Walker 1848 (p. 159) is 12 to 14 mm. long, but the locality given as Africa evidently is an error. It might be *edentulus,* as no mention is made of black hairs on the palpi.

T. nepos Walker 1848 (p. 181), being 16 mm. long and without a locality mentioned, might be *acutipalpis* or an ally.

T. circumdatus Walker (p. 185) is without locality and only 10 mm. long. It agrees with New South Wales specimens in having black hairs on the palpi, and not with *circumdatus* White which has since been renamed.

T. fraterculus Macquart 1849, is 12 mm. long, but Ricardo gives 13 to 15 mm. The type is probably from Sydney, not Tasmania as recorded.

T. abstersus Walker 1860 from New South Wales, is 10 mm.

T. brevidentatus Macquart 1854, from Sydney, only 8 mm. long, cannot belong here if, as stated, the eyes are bare.

T. antecedens Walker 1854 from Tasmania is 10 mm., but Ricardo gives 12 to 14 mm., and the name is preoccupied by a male of unknown identity from the mainland.

T. flindersi Ferguson 1921, is the *antecedens* White.

T. whitei Hardy 1939, is the *circumdatus* White.

Where the length has been given in lines (12 to the inch), that number has been doubled to render the measurement in millimeters (25 to the inch), which computation may be lower than actually the case.

The above data, though unsatisfactory for the purpose, do suggest that at least six species fall under this complex as follows: 1 *nepos* Walker (*acutipalpis* Macq.); 2 *exulans* Erichson (*edentulus* Macq.; *abstersus* Walker); 3 *hebes* Walk. (*fraterculus* Macq.); 4 *circumdatus* Walk.; 5 *flindersi* Ferguson (female of *antecedens* Walker, preoccupied); 6 *whitei* Hardy (*circumdatus* White nec Walker); 7 *brevidentatus* Macq.

Those species numbered 1, 2, 5 and 6 may be recognised species from Tasmania, whilst that numbered 4 could be recognised if New South Wales be accepted as the locality. Those under 3 are not recognisable, whilst that under 7 could hardly belong to this complex.

Tabanus acutipalpis Macquart, 1838.

This Tasmanian species is distinguished by markings of the abdomen, and those seen standing under the name from the mainland do not show those markings but have the same strongly depressed abdomen and are about equal in size; however these mainland specimens vary greatly in their frontal proportions.

A Tasmanian specimen identified by me has its frontal proportions 28:9:8 and the callus reaches from eye to eye, with a tapering extension reaching half-way towards the summit. The species resembles rather closely *T. whitei,* but the three abdominal lines of spots, of which the outer spots are oblique marks, will readily distinguish the form.

Tabanus whitei Hardy, 1939.

Authentically identified specimens standing under the name *circumdatus* are: (*a*) from Illawarra, proportions 24:8:8—compared with the type at the British Museum; (*b*) from Burnett River and Eidsvold (Queensland), proportions respectively 25:8:7 and 25:8:8—determined by Austen; (*c*) from Burnett River, 24:8:9, determined by Marshall; (*d*) Two from Mangalore (Tasmania), 23:8:9 and 25:8:8—identified by White. All these appear alike and have the frons three times longer than wide, and have only white hairs on the palpi.

Other specimens under the name *circumdatus,* however, do not agree and one, identified by Taylor, has not only a different frontal proportion, but also has black hairs on the palpi, in which it corresponds with the *circumdatus* of Australian collections prior to White's effort to determine the specific identity.

Tabanus circumdatus Walker, 1848.

In accord with Walker's description this species has the palpi "clothed with short black hairs". A specimen identified by Taylor has the palpi with some black hairs and the frontal proportions are 20:9:8, thus the length is about twice the width, as in *flindersi* Ferg.

Tabanus exulans Erichson, 1842.

The "palpis concoloribus" of the original descriptions suggests that all hairs of the palpi are white, and in this and other characters it agrees with White's interpretation of *edentulus.* Two of White's identified specimens have the frontal proportions 20:7:7 and 21:7:7, whilst a Milson Island specimen has 22:8:7, which is near enough to be conspecific. The length is three times the width.

Tabanus flindersi Ferguson, 1921.

New synonym:—Under the name *antecedens* Walker, stand a Mangalore specimen identified by White and a Flinders Island specimen identified by Austen. Together with a paratype of *flindersi* Ferg., these have the frontal proportions 20:10:7. Other paratypes of *flindersi* have 20:10:8, and it seems remarkable that Ferguson did not record his species as being conspecific with White's. A male from Mangalore is without the enlarged facets in the eyes. The species has not been seen outside Tasmania and adjacent islands.

Tabanus vestustus-complex.

The typical form of this complex belongs to the same natural group as that to which the majority of the *circumdatus*-complex falls, but with specimens under the name *vestustus*, has been included a species from Low Island (Queensland). The Low Island specimen has bare eyes but otherwise bears some resemblance, so advantage is here taken to incorporate further species with a similar appearance, leaving their individual relationships for future consideration.

All species in this complex either have a slight sandy-coloured pulverulent overlay, or else a dense white pubescence; they are all associated with coastal breeding so far as known. The appendix is present on vein R_4 and the frontal length is 2 to 3 times the width.

Key to Species of the vestustus-complex.

1.	Species with densely hairy eyes	2
	Eyes with scattered hairs or entirely bare	3
2.	Lower half of frons above the subcallus, entirely covered with a square callus. Frontal length twice the width. Body covered with a dense whitish pubescence	*rubricallosus* Ric.
	Without a frontal callus, or if abraded a small false callus may appear. The average frons length is two and a half times the width. Body sandy-coloured	*vestustus* Walk.
3.	Eyes with scattered hairs. A pear-shaped callus with a lineal extension is reported for this species which has not been seen in Australian collections. Recorded from North-West Australia ..	*umbripennis* Ric.
	Eyes entirely bare; frontal callus absent	4
4.	Frons length between eye-corners is about three times the width. New South Wales. 16 mm. ..	*vespiformis* Ferg. & Henry
	Frons length usually under two and a half times the width. Northern Australia and nearby islands. 12 mm.	*leucopterus* v.d.Wulp.

The frontal proportions of *vestustus* Walker seem to vary, the specimen from Western Australia recorded by Taylor, 1918, having 27:10:10, whilst Tasmanian specimens show 23:9:8. The type of *vespiformis* F. & H. has 30:9:9, and the type of *griseohirta* Taylor (i.e., *leucopterus* v.d. Wulp) has 21:9:8, but on *leucopterus* from Magnetic Island, identified by Taylor, the proportions are 23:9:8; other *leucopterus* identified by Ferguson and Hill show the length under $2\frac{1}{2}$ times the width for this species.

TABANUS RUBRICALLOSUS Ricardo.

Ann. Mag. Nat. Hist. (8) xiii, 1914, 478—New Caledonia.

A drawing of the frons made from the type of this species shows a form identical with a species reared by Miss K. English in New South Wales. The species is new to the Australian list, but whether it be capable of division into subspecies has yet to be determined. There are two old specimens in the Macleay Museum which are erroneously identified, and two more in the Taylor collection found without names, and the latter form part of the series reared by Miss English. The frontal proportions are 21 :11 :10.

Subgenus CYDISTOMYIA Taylor.

Taylor, Proc. Linn. Soc. N.S.Wales, 44: 1919, 47.—Section 1, Hardy 1939.

Genotype: *C. doddi* Taylor, Queensland (monotypical).

Eyes bare, and the frontal proportions are between four and nine times longer than wide, but may be more. The appendix on vein R_4 is rarely present, and never present on those forms having the frons only four times longer than wide. About 35 species fall to this genus as far as known, but it would appear to be a complex of at least three main groups.

The *posticus*-group, with the frontal proportions about four to five times longer than wide, is rather strongly represented in Australia, and is widely distributed, the remainder being mainly northern flies. The genotype was not examined, but a drawing of its frons by Mr. E. H. Zeck and some New Guinea specimens have been seen, thus the systematic position of the fly was assured. The name *Cydistomyia* probably will fall to synonymy when species of the Indo-Pacific region become better known.

New Synonym:—The *Tabanus spiolatus* of Taylor (Rec. Aust. Mus. 12: 1918, 64) has been mis-named, it being a male specimen of *T. parvicallosus* Ricardo.

Subgenus TABANUS Lin.

Linnaeus, Fauna Suec. 1861, 462—Section IV, Hardy 1939.

Genotype: *Tabanus bovinus* Lin., Europe (Designated by Latreille 1810).

Two Australian species are in accord with species of the European fauna in having the strongly converging frons, two clearly separated calli, and variegated eyes. The frontal proportion of the two Australian species is three and a half times longer than wide.

Very unfortunately, there has been a confusion in nomenclature in the literature, and the names of both these now well known species need to be changed.

TABANUS PALLIPENNIS Macquart.

Macquart, Dipt. Exot. suppl. 1, 1846, 32, nec Ferguson & Hill 1920. *Atylotus rufinotatus* Bigot 1892.—*Tabanus rufinotatus* Ricardo 1914 and 1917; Hill 1921; Ferguson 1921.—*Tabanus clesteem* Summers 1912. *Tabanus lineatus* Taylor 1913 (preoccupied); Austen 1914.

Synonymy: The new synonymy lies in substituting the name *pallipennis* Macq. for *rufinotatus* Bigot. Macquart's description agrees with this determination and not with that made by Ferguson and Hill in 1920. Moreover the latter species does not occur in any area from

which Macquart received *Tabanus,* and the common form here referred to could hardly have escaped Macquart's attentions. The words of the original description "trois callosités" which includes the subcallus*, and "un peu grisaitre" for the wings can apply only to the present species.

The type of *lineatus* has its frontal proportions 21:6:8, and the male, reared by Hill, has the normal enlarged facets in the eyes, but no sign of the white transverse band which is so obvious in the species given a new name below.

TABANUS PARTICAECUS new name.

T. pallipennis Ferguson & Hill, Proc. Linn. Soc. N.S.Wales, 45: 1920, 463; Johnston & Bancroft 1920; Hardy 1939; nec Macquart 1846.

Synonymy: As this species does not occur in any area from which Macquart secured flies, and in addition as it does not agree with any original description of these flies, and the determination made by Ferguson and Hill was only tentative, it is advisable that a new name be given to cover the form.

The name here proposed is based on the fact that the male has a white opaque horizontal bar that must render quite blind the area of the eye covered by it.

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* Mr. H. Oldroyd draws my attention to the view held by Ferguson and Hill, that the third callus was the ocellar one. However a pseudocalius is liable to form by abrasion both at the point where the obliterated anterior ocellus presumably occurred, and also on the subcallus adjacent to the lower callus. It is evident that Macquart's material was abraded but it is not known to what extent.